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upon subjects of current scientific interest. It should have been stated in the last issue of *SCIENCE* that the gift of \$300,000 to Princeton University from Mr. W. C. Procter for the establishment of fellowships was part of his gift of \$500,000, the balance having been used for the construction of a memorial dining hall in the Graduate College.

MRS. H. M. BERNARD, of London, has arranged with Professor Kellogg who is at present in London, to establish a small scholarship in the department of entomology at Stanford, to aid an advanced student for two years in an investigation of some problem in insect evolution. The scholarship will yield one hundred dollars a year besides an additional sum to pay all laboratory fees. Mrs. Bernard is the widow of the English biologist Henry M. Bernard, a student of Ernst Haeckel, at Jena, an authority on the corals and an independent investigator of evolution problems. Mrs. Bernard has recently edited and published many of her husband's notes in a book called "Some Neglected Factors in Evolution" (Putnam's). She has already established an evolution scholarship in the University of London, and expects to found others in three or four American universities.

THE library of the department of botany, Brown University, has received a gift of 150 volumes of rare botanical books, valued at \$2,000, in memory of the late Edward P. Taft, class of '54.

GOVERNOR DIX has signed the Harte bill providing for the establishment of a New York State School of Agriculture on Long Island and appropriating \$50,000 for that purpose. He says in a memorandum that plans should be formed and put into effect for the training of qualified agricultural teachers in one or more of the state normal schools and that an effort should also be made toward the introduction in the public high schools of at least the elementary study of agriculture.

PROFESSOR HENRY B. FINE has resigned the deanship of the faculty of Princeton University but continues as dean of the departments

of science and as Dod professor of mathematics. He has been granted a leave of absence for the next academic year which he will spend in Europe. Dr. William F. Magie, Henry professor of physics, has been elected dean of the faculty to succeed Professor Fine.

DR. ALFRED M. TOZZER has been appointed assistant professor of anthropology at Harvard University.

DR. GILBERT N. LEWIS, research professor of chemistry in the Massachusetts Institute of Technology, has been appointed professor of physical chemistry in the University of California, succeeding the late Willard B. Rising. Dr. H. W. Morse, now of Harvard University, becomes lecturer in chemistry. In the same institution Dr. S. J. Holmes, of the University of Wisconsin, has been appointed associate professor of zoology. The last appointment is made to fill the vacancy caused by the removal of Professor H. B. Torrey to Reed College.

#### DISCUSSION AND CORRESPONDENCE

##### PHENOTYPES, GENOTYPES AND GENS

WHILE there should be no objection to weekly revisions of the vocabulary of genetics, if any useful purpose is served, some readers of *SCIENCE* may share in the belief that special terms can have little practical value unless they continue to bear the same or closely related meanings. The word phenotype, for example, seems to have been employed by Professor Johannsen as a statistical term, for a purpose essentially different from that illustrated in Dr. Shull's recent paper, in *SCIENCE* of February 2, 1912, p. 182. Dr. Shull assures us of Professor Johannsen's authority for the new version of phenotype, but this does not destroy the historical interest of previous revelations.

To show the distinction that phenotype once conveyed, a free translation of Johannsen's most direct statement may be given:

Thus we recognize that the "type" in the Queteletian sense is merely a superficial appearance which may be deceptive; only through further investigation can it be determined whether one or many biologically different types are present.

Therefore it would be proper to designate the statistically prominent type as an apparent type (*Erscheinungstypus*), or, more briefly and directly, a phenotype (*Phaenotypus*). Such phenotypes are in themselves measurable realities; something that can be observed as typical; that is, the centers among series of variations, around which the variants are grouped. The word phenotype serves only to make the necessary mental reservation that from the appearance alone no further conclusion can be drawn. A given phenotype may be an expression of biological unity (*Ausdruck einer biologischen Einheit*), but it does not at all need to be. Indeed, this is not true, in a great majority of cases, of the phenotypes found in nature by statistical investigations of variations.<sup>1</sup>

Of course it would be presumptuous to assume that any translation would convey the exact meaning of such a passage, but at least it can be seen that phenotype was being used by Johannsen as a concrete collective term, and not merely as an abstract conception, as Shull has supposed:

"Phenotype" and "genotype," when both are rightly used, are contrasted terms, both being abstractions referring to the type to which an individual or group of individuals belongs, and not to the group of individuals belonging to that type. To illustrate the use of "phenotype" in its correct sense, reference may be made to the  $F_2$  of a Mendelian hybrid.<sup>2</sup>

When the phenotype idea was brought later on into direct contrast with the genotype idea, the two were compared as abstractions, but this conceptual refinement was for purposes of explanation and did not necessarily supplant the more concrete application of phenotype previously made. Shull need not apologize for himself or for Jennings on account of having used phenotype in a concrete sense. It may be that the first use of the term, as restricted to the statistically prominent center of the group, was too narrow for convenience, but any group that has been found to show a statistical unity could be described at least as phenotypic.

<sup>1</sup> Johannsen, W., "Elemente der Exakten Erblichkeitslehre," p. 123.

<sup>2</sup> Shull, G. H., "'Phenotype' and 'Clone,'" SCIENCE, N. S., Vol. XXXV., February 2, 1912, p. 182.

That Johannsen did not contemplate the employment of "genotype" in any such concrete sense as phenotype seems plain from the statement that accompanies his definition:

Very obvious phenotypical differences may be shown where no genotypical difference is present; and there are also cases where with genotypical diversity the phenotypes are equal. Just for this reason it is of the greatest importance to separate clearly the conception phenotype or apparent type (*Erscheinungstypus*) from the conception genotype or germ-type (*Anlagetypus*), as one might say. With this latter conception, to be sure, we shall not be able to work (*nicht operieren können*)—a genotype does not make its appearance in pure form (*tritt eben nicht rein in die Erscheinung*); but the derived concept of genotypical difference will be of use in manifold ways.

Phenotypes, as we learned from the previous quotation, are found in nature, but genotypes are not. To the unregenerate reader Johannsen's genotype appears to be nothing more than an unframed conception of a germinal or genetic constitution, considered as something apart from the external manifestation of the characters. It is an indirect and complicated substitute for the old distinction between latent and patent characters, between transmission and expression.

To replace the word genotype because it was preoccupied in taxonomic biology may not seem so necessary if it be considered merely as the name of an abstract conception with no real existence that needs to be discussed in biological literature. But that geneticists should wish to keep the word in active use as a major term after its previous history has been pointed out is only one more way of showing disregard for the taxonomic framework of biology.

The adjective use of genotype is hardly more fortunate than the substantive application. Why we should say genotypical differences instead of genetic differences or germinal differences is not obvious, but perhaps the longer word means more to geneticists. If the object was to keep closer to the idea of a germinal constitution made up of separate units or gens, the meaning could have been

conveyed more effectively by speaking of *genic* differences than by adding extra syllables. The "type" part of Johannsen's words has served only to confuse the issues, as in the passage where Shull says that phenotypes and genotypes are abstractions relating to types but not to groups. How can there be typical differences, in any biological sense, unless groups are compared? The fact seems to be that Johannsen was not using the word type in accord with biological traditions, but in a loose metaphysical way that renders the terms more abstract instead of more concrete.

There should have been no difficulty in finding suitable names for the two classes of Mendelian hybrids that Shull has pointed out, instead of allowing them to become confused with Johannsen's genotypes and phenotypes. As the so-called genotypes are supposed to have the same gens, they could be described as isogenic hybrids or isogens. Any group treated as having biological unity may be called an isogen. Johannsen approached the idea of biological unity in the passage explaining the use of phenotype, but did not provide a name for such groups except indirectly through the genotype concept.

The hybrids that have different germinal constitutions, and yet look alike, could be described as isophanic hybrids or isophans. They have the same dominant characters, but this does not involve any complete statistical or phenotypic unity. The groups are formed with reference to alternative, Mendelian characters, instead of on the basis of statistical measurements of continuous variations. As Johannsen pointed out, even genotypical unity does not preclude phenotypical differences.

Pluralizing the word *gen* is another difficulty encountered by geneticists. Johannsen used the term mostly in its German plural form, *Gene*. Our writers have added another letter making a double plural, "genes," something like "memorandas."

Johannsen proposed *gen* as a simplification of Darwin's term *pangen*, to avoid the implications of Darwin's theory of pangenesis:

Instead therefore of *pangen* (*das Pangen*) and

*pangens* (*die Pangene*), we shall simply say *gen* (*das Gen*) and *gens* (*die Gene*).

Along with this word *gen*, to represent an invisible rudiment or transmitted germ of a character, it will be useful to have a corresponding term, *phan*, to represent an external manifestation or expression of a character. To be able to refer to the external expression or phanic relations of characters is quite as important as to discuss them from the standpoint of theories of transmission. From these two roots it will be easy to develop a simple and appropriate terminology for many of the facts of heredity.

O. F. COOK

WASHINGTON, D. C.,  
February 24, 1912

#### CROSS CUTTING AND RETROGRADING OF STREAM-BEDS

IN the October (1911) number of the *American Journal of Science*, I read with interest an article by Mr. John Lyon Rich on "Recent Stream Trenching in the Semi-arid Portion of Southwestern New Mexico, a Result of Removal of Vegetation Cover," on which I have ever since intended making brief comment, because it seemed to me Mr. Rich presented only one phase of the subject. While the stated factor, "removal of vegetation cover," may in some localities, accelerate the retrograding (trenching) of stream-beds, it is not, in my opinion, the cause of retrograding. I noted the same characteristics (and others probably also noted) years ago in places where there were no cattle and never had been any.

The "trenching," Mr. Rich says, "is still in progress," which is true, for it has always been and always will be, in progress, cattle or no cattle, vegetation or no vegetation, not only in semi-arid regions but everywhere. There are differences in degree and rate—that is all—and in arid regions the rate is conspicuous.

There are two forces at work wherever water runs or ice flows, which, so far as I know, have not been sufficiently defined up to the present. They are *cross-cutting* and *retro-*